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Weapon Systems Technology Information Analysis Center

Disruptive Technologies
Achieving the Asymmetric Edge on the Battlefield

Introducing the WSTIAC 10
Key DoD Strategic Areas

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This issue of the WSTIAC Quarterly features an article on the Disruptive Technologies. Also included are recent news items related to weapon systems technology, the WSTIAC Calendar of Events and an introduction to the WSTIAC 10 from the Director. Details on several Training Courses sponsored by WSTIAC are also included in this issue. Contents of in the News: REAPER Drops First Precision-Guided Bomb, Protects Forces, Units Receives 'Task Force Marne's First MRAPS, The Truth about the Osprey, Successful Missile Defense Intercept Test Takes Place Near Hawaii, and Mine Countermeasures Exercise Sweeps Persian Gulf.

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Director's Corner

THE WSTIAC 10

Welcome to the latest edition of the *WSTIAC Quarterly*. Let me start out by saying that the WSTIAC program was extremely productive, in fiscal year 2007, in terms of collecting and disseminating information as well as in providing technical expertise on weapon systems technology. On the information side, WSTIAC supported a huge number of web inquiries, added many more documents to our library database, and provided individuals with world class weapon systems related instruction from our weapon systems technology training program. In terms of technical solutions and expertise, the program experienced an all time high in contract effort to support the greater Department of Defense community in weapon systems research, development, and acquisition.

As effective as the WSTIAC program was in fiscal year 2007, it can be much more effective in supporting our customers in both the information and technical expertise areas. As we continue to get the word out about this program, I do expect substantial growth in both information and technical assistance. Also, by focusing more directly, with more relevant capabilities, on our customers, I believe that WSTIAC will grow substantially.

As part of the effort to be more relevant to our customers (by customers I'm referring to requirements developers and users, materiel developers, and engineers/scientists) we have realigned WSTIAC based upon ten key strategic areas that the Department of Defense is emphasizing across many, if not all, of the services. These ten areas, which I call the "WSTIAC 10" (see Table below), are areas in which WSTIAC will provide enhanced expertise and information as they relate to the technological advancement of weapon systems.

It is not that other areas won't be supported by WSTIAC. Rather, the WSTIAC 10 represents areas in which we will focus much of our attention. As a result you can expect to see changes in our website, publications, brochures, and briefings to reflect these ten areas and to focus more and more on the customers that we support in WSTIAC.

Many of the categories in the WSTIAC 10 represent areas of technology that may be considered disruptive technologies. Our feature article in this edition of the *WSTIAC Quarterly* introduces the concept of disruptive technologies and discusses how they impact the current and future methods of warfare. Also presented in the article are specific areas of technology, which when developed will enhance our warfare systems and give us an edge on the future battlefield. I hope that you find the article and the rest of the publication useful in contributing to your efforts to support our warfighters.

Mark Rider
WSTIAC Director

WSTIAC 10

- Power and Energy
- Lethality
- Weapon System Command and Control
- Non-Lethal
- Weapon Systems and Munitions Readiness and Asset Visibility
- Target Identification and Engagement
- Asymmetric and Irregular Warfare
- IED Defeat
- Embedded Training Systems
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Disruptive Technologies for Weapon Systems:
Achieving the Asymmetric Edge on the Battlefield

John C. Keefe
WSTIAC
Rome, NY

"Victory will smile upon those who anticipate changes in the character of war, not upon those who wait to adapt themselves after changes occur." – General Giulio Douhet, in The Command of the Air, *1921*

INTRODUCTION

What exactly is a disruptive technology with respect to military applications?[1] It is important to understand what defines a technology as disruptive and to be able to recognize which future innovations have the potential to be disruptive. With this knowledge it can be determined how to adapt the technology or to counter the threat in a timely manner. This article will overview the concept of disruptive technologies by summarizing unclassified research and development efforts and by providing examples of technologies that may be categorized as disruptive in terms of military applications.

> "Disruptive technologies and their associated military innovations may fundamentally alter long-standing concepts of warfare. Potential adversaries are seeking asymmetric capabilities to exploit our vulnerabilities and offset our current advantages. Asymmetric capabilities are typically unpredictable and possess potential military consequences as evidenced by the human toll attributed to IED's and the readily available access to commercial micro-sensors for integration with UAVs for hostile surveillance upon friendly forces." [2]

Disruptive technology is a term popularized by a Harvard business professor and may be defined as an innovation that forces the advancement in security or degrades current security as related to changes in geopolitical, military, economic or social cohesion factors.[1, 2] Disruptive technologies do not in every case initially supplant the current technology commonly used at the time of introduction. Rather, they typically enter the field on the low end of the technology area, then outpace the development of the current technology and eventually displace the technology entirely.[1]

The impact of disruptive technologies has been taken very seriously by both business and the military. The introduction and advancement of a singular new technology can displace, damage, or eliminate entire industry segments in a very short period of time. For example, digital photography, which is now approximately 16 years old* has largely displaced film and emulsion photography, which had a lifespan of more than 150 years.

Disruptive technologies must be anticipated, understood, and effectively countered in order to minimize their impact. Those who effectively apply new disruptive technologies will gain an *asymmetrical* advantage whether in business, industry or on the battlefield.

Military Interest in Disruptive Technologies

In order to remain ahead of the changing face of warfare the military must develop disruptive technologies or weapon system enhancements which provide an asymmetrical advantage to the warfighter. *Asymmetrical warfare* can be described as a military situation where two groups of unequal power interact and attempt to exploit each other's characteristic weaknesses. This involves strategies and tactics of unconventional warfare where the "weaker" combatant must use strategies that exploit geography, timing, surprise, or specific vulnerabilities to offset deficiencies in quantity or quality of force in order to achieve victory.[3]

There is significant interest in tactics and innovations that counter disruptive technologies which have emerged in recent years that negate modern military advantages. Many potential technology solutions are rapidly approaching maturation and when they are integrated into a military system will provide a significant improvement in operational capability.[4]

DISRUPTIVE TECHNOLOGIES FOR THE MILITARY

Historical Examples of Military Disruptive Technologies

Throughout military history technological developments have substantially disrupted the methods of conventional warfare. In general terms, the evolution of weapons and weapon delivery systems, small arms, tanks, and aircraft for example, have forced changes in the warfare tactics. Over the course of many centuries

Asymmetric Warfare During WWII

Finland had a mobilized army of only 180,000 men, but these troops turned out to be fierce adversaries against 4 times as many Soviet troops by employing small-unit surrounding "motti" tactics, fast-moving ski troops in white camouflage suits, and local knowledge. Many had spent most of their lives in the forest; the vast majority of Finns were rural dwellers until the 1950s. The conditions of the winter of 1939-40 were harsh; temperatures of -40°C (-40°F) were not unusual, and the Finns were able to use this to their advantage. Often, they opted not to engage the enemy in conventional warfare, instead targeting field kitchens (which were crucial for survival in the cold weather) and picking off Soviet troops huddled around camp fires.[5]

new armor technologies have been developed to counter new weapons and new weapons have evolved to counter new armor. Speed and efficiency with which military forces can be deployed is a significant factor in determining military advantage over their adversary. Development and establishment of rail transport was in full swing during the Civil War, and the use of the railroad by General Ulysses S. Grant to move troops and supplies in the Civil War was a great tactical advantage and allowed him to quickly and continually bring the fight to the Confederate army. Radar and sonar and encrypted communications (code making & breaking) are further historical examples of military disruptive technologies, as they gave a clear edge to the side that employed the latest technology.

Current Examples of Military Disruptive Technologies

The nature of warfare today is strongly influenced by a number of technologies. Examples include interactive, real-time map systems and databases, global positioning system (GPS), and nuclear detection and elimination technologies. The following sections contain a few examples of disruptive technologies that are currently influencing conventional warfare and tactics.

Night Vision Systems

Night vision systems eliminate the tactical advantage of darkness thus enabling soldiers, rotorcraft, and ground vehicles to perform combat operations any time of day or night. Moreover, if one side has the night vision technology and the other does not, there is a substantial tactical advantage leading to the ability to conduct very effective covert operations. With the arrival of sensor fusion and the use of chip-based night vision systems the gap in capabilities between the low cost night vision systems and the current high end systems is closing. This raises a concern, in that, the availability of these systems (low cost COTS) will allow many people to readily obtain these systems as evidenced by their sale at local sporting goods and other retail stores.[6]

Reactive Armor Systems

Current combat armor systems use nonmetallic materials such as Kevlar®† and ceramic materials (e.g. boron carbide (B_4C) and aluminum oxide (Al_2O_3)) in addition to conventional metallic armor. Shaped-charged munitions and warheads countered the development of these robust advanced armor material systems. Consequently, to counter these weapons (and thereby following the weapon-armor cycle of technology development) reactive armor systems were developed and are currently employed on several weapon system platforms. In order to defeat an armor penetrating weapon, such as a shape charge, reactive armor explodes prior to impact.

Information Technology/Data Processing

Communication and coordination is critical in wartime, and the advent of wireless communication systems and the rapid advancement of information technology (data processing methods & speed) have greatly enhanced the ability to precisely engage the enemy. Furthermore, through technologies supporting command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) collection and dissemination of the most current information on enemy troop positions and other aspects of enemy conduct enables field commanders to more effectively develop, coordinate and execute their strategic battle plan. Additionally, the speed at which a military is able to provide this information is critical to success in the current environment of small unit warfare.

Logistical Support

The most advanced units of the military can usually only be deployed as far as the supply line can support. Units can go for short periods without resupply, but for long periods groups such as the Defense Logistics Agency (DLA), which currently has more than 5 million items in their inventory, provide supply-line support to the warfighter. New advances like automated pinpoint air drop systems facilitate precise delivery of supplies to strategic locations. The Air Force Air Mobility Warfare Center has led the effort to develop one such the Joint Precision Air Drop System (JPADS). Such systems represent a stealthier, more cost effective solution for resupplying front line units including special operation forces, which may be operating in difficult to reach locations.

Training

As may be gathered from this article, almost anything can be categorized as a disruptive technology, even training. The 2001 Defense Science Board Task Force Reports "The superb performance of our military in the 1990s was not just the result of technological superiority but equally of training superiority." Training allows the warfighter to effectively use the technologies that have been developed to support them and their mission.[7]

Emerging and Future of Military Disruptive Technologies

The US military is continuously looking toward future technologies that provide an evolutionary or revolutionary advancement in defense systems as well as those technologies that will provide an asymmetrical advantage on the battlefield. The application of flexible displays, small radar systems, battery improvements, MEMS (micro electro-mechanical systems) and autonomous MEMS systems show strong promise as disruptive technologies.[8] Examples of several other technologies that are being pursued are listed below. Furthermore, any combination of these technologies, which by synergy can advance the capabilities to a new level, are also of interest.[2]

- Alternative energy sources
- Net-centric systems
- Extended life batteries
- Variants of laser technologies
- Non-lethal and less-than-lethal weapons
- Devices for a reprogrammable and reconfigurable warfare system
- Advanced chem-bio and optical sensors
- Small radar systems
- Automatic target recognition systems
- MEMS (micro-electro-mechanical systems)
- Unmanned, guided platforms, active and passive (land, air & sea)
- Autonomous robotic devices (bomb sniffer, ordnance disposal tool, ISR)
- Smart autonomous surveillance (SAS)
- Continuous Tagging, Tracking, & Locating
- Biometrics for identification
- Persistent surveillance

- Understanding the "human terrain"
- Hypersonic jet engines
- Electro-magnetic (EM) railgun
- Persistent Littoral Underwater Surveillance (PLUS)
- Cloned or tailored organisms
- Nanotechnologies
- Biochemical agents
- Seabase enablers
- Tactical Satellite (TACSAT)
- Free electron laser

There is no structured way to determine how disruptive technologies can be applied. Examples of technology fields that may be ready to provide disruptive technologies in the short term include: gene therapy, wireless communication, automatic target recognition, MEMS (micro-electro-mechanical systems), cloned or tailored organisms and nanotechnologies.

How will future devices function in a reprogrammable and reconfigurable warfare system? The systems that the US military will be using will be in itself a disruptive technology by allowing the commander to gain the highest level of flexibility in the multifaceted control and operation of warfare. Improvement in antenna technology will allow for increases in data bandwidth, which will allow a higher volume of information and data to flow.[10]

> Now USSOCOM Commander ADM Eric T. Olson was quoted in a *2004, Disruptive Technology Briefing* that "The SOF warrior: (is) a disruptive force in a complex environment. These continuously evolving capability increases will allow SOF to not only conduct, find and fix operations globally, but also to disrupt or even disintegrate the terrorist organizations."[9]

Environmental, Chemical and Biological Sensors

Challenges facing new sensor systems is that they must work in many different types of environments to be effective tools of the warfighter. The development and use of advanced sensors can create disruptive technologies in terms of their ability to remotely detect many conditions and provide intelligence, surveillance and reconnaissance in locations and situations that were not previously possible.

The advantages of chem-bio sensors are their ability to sense single molecules to detect a chemical or biological attack and to act as an "artificial nose" to identify specific chem-bio spectra. The identification of a specific signature of the chem-bio spectrum (e.g., smells, odors, perfumes) can determine the presence of many things within a specific area, on a person or device. Chemical and biological sensors are certainly being used today, but an example of a future evolution of these technologies is the self-sustaining system which combines the sensors with a permanent energy source. These future systems will use energy harvesting devices that absorb very low levels of vibration and convert it to a usable form of energy to power these devices. Also, coupling the use of specific taggants with these sensors can make effective tracking possible.[11]

Biometrics and Identification Systems

Personnel identification systems have employed biometric technologies, which use finger prints, photo recognition software, iris images, DNA and other sources, to more accurately and rapidly determine the identity of an individual.[12] In order to carry out some of their clandestine missions Special Operations Forces (SOF) must be able to locate, track, and identify human beings and other important targets. They must also be able to detect and identify targets based on their unique observable characteristics using devices that are sufficiently clandestine to be effective without exposing themselves to risks. The Special Operations Command (SOCOM) has made an extensive effort to supply SOF with equipment to achieve these goals. Many of the technologies used in this area are linked to the nanotechnology, biotechnology and chemical families of technological development, as shown in Table 1.

Unmanned Systems and Robotics

Robotics are used as a multifunctional platform for an array of sensors and are intended to reduce the amount of human contact that is required for the investigation of many potentially deadly wartime situations. Such systems are used as bomb sniffers, ordnance disposal tools and observation stations. There has been a rapid expansion of the use of UAV's and other unmanned devices as key tools for the warfighter in combat and intelligence, surveillance and reconnaissance missions.[14]

Human Factors Modeling

A disruptive technology need not be a weapon in the traditional sense but one which seeks to provide more accurate intelligence into the nature of human actions and interactions. With this information commanders will have a tool to gage the human element as they enter the battle space. Understanding the "human terrain" is just as important as having the right weapons. Being

Table 1. **Key Enabling Technologies for Continuous Tagging, Tracking, and Locating[13].**

Nanotechnology	Biotechnology	Chemical Technology
Clandestine devices	Biomimetic devices for detection and identification at long distances	Signature enhancing taggants
High functional-density devices	Bio-based devices for detection and identification at long distances	Chemical/biochemical Sensors for natural signatures
Self-organizing, self-deploying devices	Taggants for biological signature amplification, translation	
Processing and communications	Natural signature detection and identification	
Energy harvesting		

able to understand the local culture is very important, but to do this effectively requires "boots on the ground" to make meaningful assessments. By gathering more lessons learned in the field more accurate intelligence can be formulated.[15]

Human social culture behavior modeling is complex, but it is an area that is vital to supporting our traditional war fighting methods. Although it is in its formative stages, it is emerging as a science that can use predictive models as we would use equations to predict projectile trajectory.

DEVELOPMENT AND IMPLEMENTATION OF DISRUPTIVE TECHNOLOGIES

Time is of the essence in our current state and any mature or applicable technologies that can be moved to the field can make an impact now. Technologies that are at TRL 6 (technology readiness level 6 – a technology ready for introduction) must be advanced as soon as possible. Fielding the innovation is where most emerging technologies have the greatest transitional road blocks to surmount.[9] Those who know the process will be rewarded in the speed by which their technology gets to the field.[16] Partnerships would allow complex technologies to be developed and moved forward more quickly.[9]

The acquisition system must be responsive to the development of disruptive technologies and not limit their introduction. (This however is not an impediment in the black world.) The capability to produce disruptive technologies rests on the factors of knowledge, imagination, resources, and time. The greatest challenge is to find and develop imagination. The lists that are developed must be weighed with the insight to determine plausible versus possible technologies.[2] Three key questions need to be asked about potential disruptive technologies: What will it do? What capability does it produce? Why does this technology matter?[17] There are many groups looking at disruptive technologies and it is important to avoid duplication of effort. This can only be avoided if the each military command makes the effort to look at what other commands are involved with.[18]

To find new disruptive technologies several sources should be considered, including:[17]

- Awarded grants that are intended to develop new technologies / methodologies
- New programs that are starting up to discover what is being developed
- New product offerings in the commercial market – commercial off the shelf (potential for adaptability)
- Combinations of conventional technologies that synergize and result in a new disruptive technology.

FUTURE TECHNOLOGY NEEDS

Looking ahead to the warfare environment in the 2015-2020 time period, the picture is complex. This is partly because many areas of US dominance have been eroded in the S&T world, including the pace of American students getting advanced degrees and the reduction in the pace of innovation by US companies and labs. This can greatly lessen the key edge of overall knowledgebase in all S&T areas and accordingly lessen disruptive technologies being created and applied. As a consequence this can lead to a rise in capability by those groups or countries looking to supplant our asymmetrical technological and warfare advantages.[19] Given these changing trends specific technology needs have been identified.

There are currently existing conditions that render the security of the world's nuclear arsenal less than secure. One approach to resolving these issues is to focus on three areas: intelligence, detection and elimination of nuclear threats. Detection is perhaps the most difficult to achieve, and technologies that enhance detection and improve the process are needed.[20]

While nuclear issues are at the top of the list when considering disruptive technologies, other key areas to target for possible applications are bio, nano and information technology.[17, 21] Additionally, extended life batteries, alternative energy sources and non-lethal and less-than-lethal weapons are technologies in demand.[22] Access to information in real time by the warfighter, and therefore the development of net-centric systems, will also be key to mission success.[18]

The expanded use of smart autonomous surveillance systems will provide data in amounts that will strain our ability to process the gathered information. The number of people required today to interpret the data from UAV's and other sensor platforms can be great.[23] Technologies for processing this volume of data will relieve the manpower currently dedicated to the task.

Computer systems should be used to simulate and predict performance with respect to the impact of disruptive technologies. Better prediction will lead to better application but validation is vital to ensure the usefulness of complex computer modeling. Much future discovery could take place from the use of system modeling, computation, selected lab work and then the actual production of a working model for validation.[24]

CONCLUSIONS

There is a new way to look at technology, its application and its relationship to warfare. By challenging the old concepts of just improving existing technologies to make them "bigger, better and faster", an important principle is discovered that indicates that the introduction of new technologies gives an asymmetric advantage, an edge, which was not present before.

New ideas must be examined to see what new technologies and ideas fit the mold of a possible disruptive technology. From this it can be determined that if developed, it would create an asymmetric advantage.

"The first rule of unrestricted warfare is that there are no rules; nothing is forbidden. Unrestricted warfare employs surprise and deception and uses both civilian technology and military weapons to break the opponent's will."[25] New disruptive technologies will be determined and deployed by adversaries without limits or concerns on their part. Our part will be to establish a system to determine possible disruptive technologies, develop them, quickly deploy them and be able answer any new threats in a timely manner with our understanding of how the nature of disruptive technologies operates.

This past September, the 2007 Disruptive Technologies Conference, "Turning Lists into Capabilities," was held in Washington D.C. For more information on the subject, refer to the conference proceedings, which are posted at: http://www.dtic.mil/ndia/2007disrupt/2007disrupt.html

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† Kevlar is a registered trademark of the E.I. du Pont de Nemours and Company.

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in the news...

REAPER DROPS FIRST PRECISION-GUIDED BOMB, PROTECTS FORCES

by Staff Sgt. Trevor Tiernan
US Central Command Air Forces Public Affairs

SOUTHWEST ASIA (Air Force Print News) – The MQ-9A Reaper demonstrated it's unique precision strike capability as a hunter-killer attack platform by dropping its first precision-guided bomb Nov. 7.

"The beauty of the MQ-9 Reaper is that we're able to synchronize and integrate unmanned aerial attack platforms over the skies of Afghanistan, allowing us to persistently and consistently track the enemy and ensure that we place the appropriate ordnance on target when required, and maintain that persistent presence after weapons release," said Lt. Gen. Gary North, US Central Command Air Forces commander.

The Reaper, the Air Force's unmanned aerial attack vehicle, was operating over the Sangin region of Afghanistan on the hunt for enemy activity when the crew received a request for assistance from a joint terminal attack controller on the ground. Friendly forces were taking fire from enemy combatants. The JTAC provided targeting data to the pilot and sensor operator, who fly the aircraft remotely from Creech Air Force Base, Nev. The pilot released two GBU-12 500-pound laser-guided bombs, destroying the target and eliminating the enemy fighters.

The ability to carry bombs, in addition to AGM-114K Hellfire missiles, is just one of the features that set the Reaper apart from its smaller brother the MQ-1 Predator. "The MQ-9 gives us an incredible addition to the arsenal," General North said. "It's larger, carries an increased payload and is able to fly longer, higher and faster. It's an incredible addition to our attack capability in the CENTAF force lay-down."

The Reaper has flown 49 combat sorties since it first began operating in Afghanistan Sept. 25. It completed its first combat strike Oct. 27, when it fired a Hellfire missile over Deh Rawod, Afghanistan, neutralizing enemy combatants.

UNIT RECEIVES 'TASK FORCE MARNE'S' FIRST MRAPS

by Sgt. Michael Connors

CAMP LIBERTY, Iraq - Soldiers from 1st Battalion, 30th Infantry Regiment, 2nd Brigade Combat Team, 3rd Infantry Division, recently became the first in Task Force Marne to receive the Army's new mine-resistant, ambush-protected vehicles, known as MRAPs. They completed MRAP drivers training here Nov. 8 and will be returning to their respective bases with about 20 MRAPs. MRAP fielding will continue steadily, with a goal of having the entire task force outfitted by February, said Army Sgt. 1st Class Jabari Williams, the 2nd BCT's noncommissioned officer in charge of MRAP fielding.

MRAPs come in two categories. Category 1 holds up to six soldiers and will replace the Humvee. Category 2 is a longer version, which can hold a crew of 10 soldiers. "It's a good opportunity for us," said Army Sgt. David Ipock. "Any time we get a new vehicle with more protection, it's a good thing."

Prior to the vehicles being handed over to the units for day-to-day use, the soldiers got five days of training on how to operate, drive and maintain the vehicles. The training included classroom instruction and on- and off-road driving. This training also introduced the soldiers to some new features the Humvee lacked, such as a pneumatic rear ramp and a shock-absorbing seating system with four-point seat belts. "The bomb protection with the seats – I think that might help a lot," said Ipock. "Everything's just more advanced – the switches and gauges, things like that."

Army Spc. Daniel Lopez also weighed in with what he liked about the new vehicle. "It's a big, new toy to replace the 1151 (Humvee) – a lot more room," he said. "I feel more secure in it than the 1151."

The training not only familiarizes soldiers with the vehicles, but also builds confidence by giving them the opportunity to drive the vehicles over steep hills and through tight turns. "It handles fairly well for a tall vehicle; as far as the suspension and handling, I was fairly impressed with it," said Army Staff Sgt. Steve Stutzman. "I went down a 60-degree hill and hit the brakes, nose first, and we just sat there – the vehicle has really good air brakes."

MRAPs are designed to be both safe and effective for soldiers conducting patrols, convoy security and missions

throughout Iraq. They are being fielded to units that need them the most and that operate in areas with the highest threat, officials said. The goal is for each platoon eventually to have four MRAPs, Williams added.

(Army Sgt. Michael Connors serves with Multinational Division Center Public Affairs. Mark B. Matthews, 27th Public Affairs Detachment, contributed to this story.)

THE TRUTH ABOUT THE OSPREY

by Col. Glenn Walters, Headquarters Marine Corps Aviation

HEADQUARTERS MARINE CORPS — Unlike most of the V-22 critics, I have actually flown the MV-22 Osprey. I flew hundreds of hours in this remarkable aircraft when I commanded the Marine Corps' test and evaluation squadron 2003-2006, and I am obliged to tell the truth.

The truth is the Osprey is the most thoroughly tested aircraft in the history of aviation for one fundamental reason: the safety of its passengers. Our Nation expects that the military will use the best engineered, maintained, and operated equipment available. Our troops deserve it. The Osprey we are flying today is just that.

Some critics say that we haven't flown the Osprey in the desert. Not true. My squadron flew in desert environments on multiple occasions totaling months of tests. The squadron now in Iraq completed several desert training periods prior to deploying. In fact, we just had another squadron of MV-22s in California and Arizona doing more of the same. Not only can the Ospreys fly in the desert, the aircraft's advanced technology makes it easier than in any other rotorcraft to land in brownout conditions.

Other critics point out that the MV-22 does not have a forward-firing weapon, but none puts this in context: no medium or heavy lift aircraft in the US inventory has a forward-firing weapon. MV-22s flying in Iraq have ramp-mounted machine guns which have become the standard on our aircraft in operations in Afghanistan and Iraq, based on the threat. That, and the inherent capabilities of the aircraft (range, speed and altitude), give the MV-22 the ability to reduce susceptibility and vulnerability to many threats.

The MV-22 has limited visibility through the cabin windows, much like the CH-46 and the CH-53E, but what most critics do not know is that the troop commander, who rides in the back of the Osprey, has unparalleled situational awareness from the on-board precision navigation system with moving maps and a significant communications capability. These capabilities are not an option in existing Marine Corps aircraft.

The MV-22 is the most maneuverable medium lift assault support platform in the world. Conventional helicopters are limited to standard rotary wing tactics and airspeeds, while the MV-22 has the ability to fly like a turboprop airplane as well as a conventional helicopter. As an airplane, it can climb or descend at a significantly higher rate than any helicopter and transit at much higher speeds. The MV-22 can also get in and out of landing zones faster than any other medium lift helicopter.

Vortex Ring State (VRS) is a phenomenon experienced by all rotorcraft—not just the Osprey. While the MV-22 is the only aircraft with a warning system that alerts pilots to VRS conditions, it is the least susceptible to this phenomenon. Additionally, because of the inherent flight characteristics of a tilt-rotor, and with the execution of a routine procedure, the MV-22 can fly out of VRS almost instantaneously by simply tilting the nacelles forward and flying out of the condition. In a helicopter the procedure is much more involved.

Perhaps we should judge the MV-22 on its current performance, not on its past.

To argue whether the aircraft is worth the money spent is an unending debate. To the injured Marine or soldier whose life is saved due to the unparalleled capabilities of the MV-22, I would posit that the aircraft is worth every penny.

Walters heads the Marine Corps' aviation plans section in the Pentagon and previously commanded Marine Tiltrotor Operational Test and Evaluation Squadron 22 (VMX-22). This commentary first appeared in the North County Times (California) on Nov. 15.

SUCCESSFUL MISSILE DEFENSE INTERCEPT TEST TAKES PLACE NEAR HAWAII

Missile Defense Agency News Release

Lieutenant General Henry "Trey" Obering, Missile Defense Agency director, announced that an important test of the Terminal High Altitude Area Defense (THAAD) element of the Ballistic Missile Defense System was successfully completed, resulting in the intercept of a ballistic missile target at the Pacific Missile Range Facility off the island of Kauai in Hawaii. Preliminary indications are that planned flight test objectives were achieved. The intercept involved the "exo-atmospheric" (outside earth's atmosphere) "hit to kill" destruction of a unitary (non-separating) target representing

a "SCUD"-type ballistic missile launched from a mobile platform positioned off Kauai in the Pacific Ocean. The interceptor was launched from the THAAD launch complex at the Pacific Missile Range Facility.

This was the 31st successful "hit to kill" intercept in 39 tests since 2001 by ground and sea-based interceptors against short, medium and long-range ballistic missile targets.

The primary objective of this test was to demonstrate integrated operations of the system, including radar, launcher, fire control equipment and procedures, and the interceptor to detect, track and destroy the target missile using only the force of a direct collision between the interceptor and the target missile – hit to kill technology. Other objectives included demonstrating performance of an interceptor that had been "hot conditioned," or heated to a certain temperature before launching; and demonstrating the ability of the interceptor to perform correctly in the "endgame," or final seconds before target intercept. The ability of soldiers from the US Army to conduct launcher, fire control and radar operations was also observed.

This was the fourth successful intercept for the current THAAD program in four tests and the third test of the THAAD system at Pacific Missile Range Facility. The first test at the Pacific Missile Range Facility was a successful high-endoatmospheric (just inside earth's atmosphere) intercept of a SCUD-type unitary target in January of this year. The second test this past April, also a success, involved the intercept of a "mid endoatmospheric" (inside earth's atmosphere) unitary target representing a "SCUD"-type ballistic missile. Soldiers of the 6th Air Defense Artillery Brigade stationed at Fort Bliss, Texas operated all THAAD equipment during all tests, conducting operations of the launcher, fire control and communications and radar. Their interaction with the complete THAAD system provided valuable test and operations experience for the soldiers, and contributed to the operational realism of the tests.

THAAD is the first weapon system with both endo-atmospheric and exo-atmospheric capability developed specifically to defend against short, medium and intermediate range ballistic missiles. The THAAD system will provide high-altitude missile defense over a larger area than the complementary Patriot system, and, like the Patriot, intercepts a ballistic missile target in the "terminal" phase of flight—the final minute or so when the hostile missile falls toward the earth at the end of its flight. Patriot and THAAD, as well as the long-range Ground-based Midcourse Defense and the sea-based Aegis Ballistic Missile Defense, all use "hit to kill" technology.

The Ballistic Missile Defense System now in development and testing will be capable of providing a layered, integrated defense for the US homeland, our deployed forces, allies and friends against ballistic missiles of all ranges, in all phases of flight—boost, midcourse and terminal. The higher-altitude and theater-wide protection offered by THAAD provides more protection of larger areas than lower-tier systems like Patriot alone. THAAD can be transported by air to wherever it is needed worldwide, and consists of radar, fire control unit, missile launchers, and interceptor missiles.

The THAAD Program is managed by the Missile Defense Agency in Washington, DC, and executed by the THAAD Project Office in Huntsville, Ala. Lockheed Martin Corporation is the prime contractor.

News media point of contact is Rick Lehner, Missile Defense Agency, at (703) 697-8997 or Richard.lehner@mda.mil for Pam Rogers, Missile Defense Agency, at (256) 450-1421 or (256) 503-3726 or pamela.rogers@mda.mil

MINE COUNTERMEASURES EXERCISE SWEEPS PERSIAN GULF

by Chief Mass Communication Specialist (SW) Craig Strawser, USS Wasp Public Affairs

USS WASP, At Sea (NNS) — The US Navy conducted a mine countermeasures exercise (MCMEX) Nov. 12-15 to demonstrate its ability to counter potential mine-laying and to maintain open sea lanes and anchorages in the region, an important mission of Maritime Security Operations (MSO).

The exercise brought together Mine Countermeasures Division (MCMDIV) 31, the "Blackhawks" of Helicopter Mine Countermeasures Squadron (HM) 15, USS Wasp (LHD 1) and USS Gladiator (MCM 11).

Cmdr. Scott Davies, commodore of MCMDIV 31, stressed the importance of teamwork in carrying out the MCM evolution. "The MCM triad consists of air units, surface units and underwater units, all working together with an afloat command element," said Davies. "By forging these three branches of the MCM process into one cohesive team,

COMCMDIV 31 is able to meet the US 5th Fleet objectives of maintaining open sea lanes throughout the region."

During the exercise, HM 15's MH-53E helicopters towed MK-105 Magnetic Influence Minesweeping Systems, better known as "sleds," which are high-speed catamaran hydrofoil platforms. From the sleds, an electrically-charged cable streams and creates an electromagnetic field, which tricks mines into thinking it is a ship.

As part of the exercise, Wasp demonstrated its ability to launch and recover the sleds from its well deck. Once the sleds were launched, rigid hulled inflatable boats towed them away from the ship where they were then connected to a hovering MH-53E and towed in a notional mine threat area.

Gladiator, the surface element of the triad, provided real-time clearance information to the command staff aboard Wasp Davies said.

Davies added, MCM ships such as Gladiator conduct mechanical and influence sweeps of Sea Lanes of Commerce, or the "highways" used by commercial shipping traffic to move material around the world.

This is the sixth MCMEX in the Persian Gulf since 2007 in support MSO. It also supports the US Naval Forces' new "Cooperative Strategy for 21st Century Seapower," which was rolled out in October by Chief of Naval Operations Adm. Gary Roughead.

For more news from Commander, US Naval Forces Central Command/Commander, US 5th Fleet, visit www.news.navy.mil/local/cusnc/.

PERSIAN GULF - An MH-53E Sea Dragon, from Helicopter Mine Countermeasure Squadron (HM) 15, performs mine countermeasure training using the MK-105 sled. HM-15 is deployed aboard the multipurpose amphibious assault ship USS Wasp (LHD 1). Wasp is conducting mine countermeasure exercises to demonstrate the US Navy's ability to defend against mine-laying operations and ensure open access to sea lanes. US Navy photo by Lt. Cmdr. John L. Kline.

WSTIAC's New Online Library Search Engine

WSTIAC recently added an online document search tool that allows users to navigate through the library holdings related to weapon systems technology.

A document search of the WSTIAC bibliographic database produces references to documents which reside in WSTIAC's physical library holdings.

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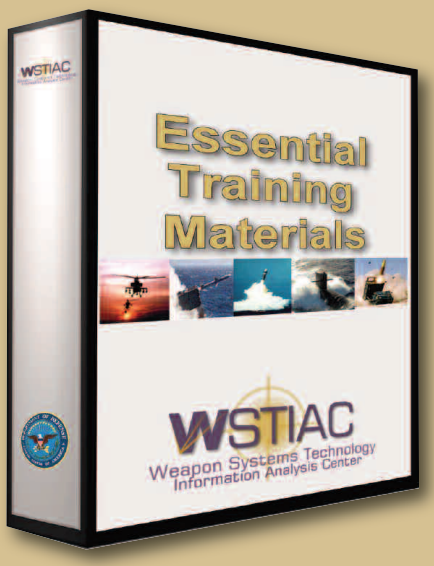

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The objective of this course is to inform materiel and combat developers, systems analysts, scientists, engineers, managers and business developers about the IED threat and countermeasures.

INTRO TO SENSORS AND SEEKERS

Provides an introduction to the most commonly used sensors and seekers employed in smart munitions and weapons. It is oriented to managers, engineers and scientists who are engaged in smart weapons program development and who desire to obtain a deeper understanding of the sensors they must deal with, but who do not need to design or analyze them in depth.

SYSTEMS ENGINEERING FOR PRODUCT LIFE CYCLE MANAGEMENT

Provides a comprehensive overview of the discipline of Systems Engineering and how it is applied over the life cycle of a product. The field has been evolving and new systems engineering frameworks and definitions are presented.

SMART/PRECISION WEAPONS

This course is aimed at providing general knowledge about smart weapons technology and a source of current information on selected US programs across the military services including system description, concept of employment, performance characteristics, effectiveness and program status.

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calendar of events

Upcoming Conferences and Courses

January 2008

46th AIAA Aerospace Sciences Meeting and Exhibit
7-10 January 2008
Reno, NV
http://www.aiaa.org/content.cfm?pageid=230&lumeetingid=1065

2008 Homeland Security Science & Technology Stakeholders Conference – West
14-17 January 2008
Washington, DC
http://www.ndia.org/meetings/8690

Network Centric Warfare 2008
22-25 January 2008
Washington, DC
http://www.iqpcevents.com/ShowEvent.aspx?id=41390&details=41340

AIAA Strategic and Tactical Missile Systems Conference
23-24 January 2008
Monterey, CA
http://www.aiaa.org/content.cfm?pageid=230&lumeetingid=1509

Counter IED & EFP Summit 2008
28-30 January 2008
Arlington, VA
http://www.iqpcevents.com/ShowEvent.aspx?id=39650&details=39664

Tactical Power Sources Summit 2008
28-30 January 2008
Washington, DC
http://www.iqpcevents.com/ShowEvent.aspx?id=41164&details=41184

Total Asset Visibility for Defense 2008
28-30 January 2008
Alexandria, VA
http://www.iqpcevents.com/ShowEvent.aspx?id=38812&details=40090

Military Testing & Evaluation Summit 2008
28-30 January 2008
Washington, DC USA
http://www.iqpcevents.com/ShowEvent.aspx?id=42892

February 2008

2008 Tactical Wheeled Vehicles Conference
3-5 February 2008
Monterey, CA
http://www.ndia.org/Template.cfm?Section=8530

US Air Force T&E Days
5-7 February 2008
Los Angeles, CA
http://www.aiaa.org/content.cfm?pageid=230&lumeetingid=1890

Defense Systems Acquisition Management Course (DSAM)
10-14 February 2008
Phoenix, AZ
http://www.ndia.org/Template.cfm?Section=802B

2008 Warheads & Ballistics Classified Symposium
11-14 February 2008
Monterey, CA
http://www.ndia.org/Template.cfm?Section=8480

Weaponeering Training Course
12-14 February 2008
Huntsville, AL
http://wstiac.alionscience.com/pdf/2008Weaponeeringsheet.pdf

24th Annual National Test & Evaluation Conference
25-28 February 2008
Palm Springs, CA
http://www.ndia.org/Template.cfm?Section=8910

3rd Space Exploration Conference & Exhibit
25-28 February 2008
Denver, CO
http://www.aiaa.org/content.cfm?pageid=230&lumeetingid=1989

Space Systems Engineering & Risk Management Symposium
26-29 February 2008
Los Angeles, CA
http://www.aero.org/conferences/riskmgmt/

March 2008

2008 Ground Robotics Capabilities Conference & Exhibition
3-6 March 2008
San Antonio, TX
http://eweb.ndia.org/eweb/DynamicPage.aspx?Site=ndia&Webcode=EventList

Systems Engineering for Product Life Cycle Management Training Course
4-6 March 2008
Huntsville, AL
http://wstiac.alionscience.com/pdf/2008SystemsEngTrng.pdf

24th Annual National Logistics Conference & Exhibition
10-13 March 2008
Miami, FL
http://eweb.ndia.org/eweb/DynamicPage.aspx?Site=ndia&Webcode=EventList

Unmanned Aerial Vehicle (UAV) Summit 2008
25-28 March 2008
Herdon, VA
http://www.iqpcevents.com/ShowEvent.aspx?id=42486&details=43736

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